CLAIMS

What is claimed is:

1. A method for enhancing transdermal transport, comprising:

increasing a permeability of an area of a membrane with a permeabilizing device;

monitoring the permeability of the area of membrane;

transporting a substance into and through the area of membrane.

2. The method of claim 1, wherein the step of increasing a permeability of an area of membrane with a permeabilizing device comprises:

applying electricity to the area of membrane;

measuring at least one electrical parameter of the area of membrane; and

controlling the permeabilizing device based on the at least one electrical parameter.

3. The method of claim 1, wherein the step of increasing a permeability of an area of membrane with permeabilizing device comprises:

creating a volume of fluid adjacent the area of membrane, said fluid having an initial concentration of a first substance; and

applying the permeabilizing device to the area of membrane.

4. The method of claim 3, wherein the step of monitoring the permeability of the area of membrane comprises:

monitoring changes in the concentration of the first substance; and

controlling the permeabilizing device based on the changes in the concentration of the substance.

5. The method of claim 1, wherein the step of increasing a permeability of an area of membrane with a permeabilizing device comprises:

creating a volume of fluid adjacent the area of membrane;

determining a reference value for an electrical parameter of the volume of fluid; and

applying the permeabilizing device to the area of membrane.

6. The method of claim 5, wherein the created volume fluid is selected from the group consisting of a liquid, a gel, and a solid.

7. The method of claim 5, wherein the step of monitoring the permeability of the area of membrane comprises:

monitoring changes in the electrical parameter of the volume of fluid; and

controlling the permeabilizing device based on the changes in the electrical parameter of the volume of fluid.

8. The method of claim 1, wherein the step of increasing a permeability of an area of membrane with a permeabilizing device comprises:

providing a first electrode in electrical contact with a first area of membrane;

providing a second electrode in electrical contact with a second area of membrane;

measuring an initial conductivity between said electrodes; and

applying the permeabilizing device to said first area of membrane.

9. The method of claim 8, wherein the step of monitoring the permeability of the area of membrane comprises:

measuring a second conductivity between said first and second electrodes;

processing said initial conductivity and said second conductivity to establish information on a time-variation of membrane conductance;

calculating at least one parameter describing a kinetics of membrane conductance changes responsive to said information; and

terminating said application of said permeabilizing device in response to a desired value for said at least one parameter.

10. The method of claim 1, wherein the step of transporting a substance across an outer surface of the area of membrane comprises:

extracting a body fluid from or through said area of membrane;

collecting said body fluid; and

sensing the presence of said at least one analyte in said body fluid.

11. The method of claim 1, wherein the substance is a drug.

12. The method of claim 1, wherein the substance is a vaccine.

13. The method of claim 1, wherein the substance includes at least one component of interstitial fluid.

14. The method of claim 1, wherein the permeabilizing device is an ultrasound-producing device.

15. The method of claim 1, wherein the permeabilizing device is a device that produces a force selected from the group consisting of chemical, electroporation, mechanical, disrupting, tape stripping, and laser forces.

16. The method of claim 1, wherein the membrane is selected from the group consisting of biologic skin and synthetic skin.

17. A method for enhancing a permeability of an area of skin comprising:

increasing the permeability of the area of skin with a skin permeabilizing device;

applying electricity to the area of skin;

measuring at least one electrical parameter of the area of skin; and

controlling the skin permeabilizing device based on the at least one electrical parameter.

18. The method of claim 17, further comprising:

applying electricity to the area of skin before increasing the permeability of the area of skin with a skin permeabilizing device; and

measuring a baseline for the at least one electrical parameter.

19. The method of claim 17, wherein the step of applying electricity to the area of skin comprises:

applying a first source having a first frequency to the area of skin; and

applying a second source having a second frequency to the area of skin.

20. The method of claim 19, wherein the step of measuring a first electrical parameter comprises:

measuring the at least one electrical parameter at the first frequency; and

measuring the at least one electrical parameter at the second frequency.

21. The method of claim 17, further comprising:

coupling a first electrode with the area of skin;

coupling a second electrode with the skin; and

measuring the at least one electrical parameter using the first electrode and the second electrode.

22. The method of claim 21, wherein the first electrode is coupled with a portion of stratum corneum of the area of skin.

23. The method of claim 22, wherein the second electrode is coupled with a portion of epidermis over which the stratum corneum has been removed.

24. The method of claim 22, wherein the second electrode is coupled with a portion of stratum corneum of the skin.

25. The method of claim 21, wherein at least one of the first and second electrode is coupled through a conductive medium.

26. The method of claim 25, wherein the conductive medium a gel.

27. The method of claim 25, wherein the conductive medium is a liquid.

28. The method of claim 21, wherein the second electrode is placed on the skin.

29. The method of claim 17, further comprising:

comparing the at least one electrical parameter with the baseline, and

wherein the step of controlling the skin permeabilizing device comprises discontinuing the application of the skin permeabilizing device based on the comparison.

30. The method of claim 19, wherein the first source comprises a voltage source having a frequency of about 10 Hz.

31. The method of claim 19, wherein the second source comprises a voltage source having a frequency of about 1 kHz.

32. The method of claim 17, wherein the parameter is selected from the group consisting of impedance, conductance, capacitance, current, and voltage.

33. The method of claim 17, wherein said skin permeabilizing device comprises an ultrasound-producing device.

34. The method of claim 20, wherein the step of controlling the skin permeabilizing device comprises decreasing a characteristic of the skin permeabilizing device when the measurement of the at least one electrical parameter at the first frequency and, the measurement of the at least one electrical parameter at the second frequency differ by less than a predetermined amount, the characteristic selected from the group consisting of intensity and duty cycle.

35. The method of claim 19, wherein the step of controlling the skin permeabilizing device comprises decreasing a characteristic of the skin permeabilizing device when a rate of change between the one electrical parameters reaches a predetermined value, the characteristic selected from the group consisting of intensity and duty cycle.

36. An apparatus for enhancing permeability of an area of skin comprising:

a skin permeabilizing device configured to increase a permeability of the area of skin;

an electrical source operable to apply electricity to the area of skin;

a circuit to measure at least one electrical parameter of the area of skin; and

a controller responsive to the circuit and operable to control the skin permeabilizing device.

37. The apparatus of claim 36, wherein the electrical source comprises:

a first source having a first frequency; and

a second source having a second frequency.

38. The apparatus of claim 37, wherein the circuit measures the at least one electrical parameter of the area of skin at the first frequency and to measure the at least one electrical parameter of the area of skin at the second frequency.

39. The apparatus of claim 36, further comprising:

a first electrode coupled on the area of skin; and

a second electrode positioned on the skin;

wherein the circuit measures the first parameter of the area of skin between the first electrode and the second electrode.

40. The apparatus of claim 39, wherein the first electrode comprises an electrode that is coupled to a portion of stratum corneum of the area of skin.

41. The apparatus of claim 40, wherein the second electrode comprises an electrode that is positioned on a portion of epidermis over which the stratum corneum has been removed.

42. The apparatus of claim 39, wherein the first electrode comprises an electrode having a first surface area and coupled to a portion of stratum corneum of the area of skin.

43. The apparatus of claim 42, wherein the second electrode comprises an electrode having a second surface area positioned on a portion of stratum corneum of the skin, and further wherein the second surface area is substantially larger than the first surface area.

44. The apparatus of claim 40, wherein the controller compares the measurement of the at least one electrical parameter at the first frequency with the measurement of the at least one electrical parameter at the second frequency and turn off the skin permeabilizing device when they differ by less than about a predetermined amount.

45. The apparatus of claim 37, wherein the first source comprises a voltage source having a frequency of about 10 Hz.

46. The apparatus of claim 37, wherein the second source comprises a voltage source having a frequency of about 1 kHz.

47. The apparatus of claim 38, wherein the parameter is selected from the group consisting of impedance, conductance, capacitance, current, and voltage.

48. The apparatus of claim 37, wherein the controller compares the measurement of the at least one electrical parameter at the first frequency with the measurement of the at least one electrical parameter at the second frequency and decrease an intensity of the skin permeabilizing device source when they differ by less than about a predetermined amount.

49. The apparatus of claim 38, wherein the controller compares the measurement of the at least one electrical parameter at the first frequency with the measurement of the at least one electrical parameter at the second frequency and decrease a duty cycle of the skin permeabilizing device source when they differ by less than about a predetermined amount.

50. A method for enhancing permeability of an area of skin comprising:

creating a volume of fluid adjacent the area of skin, said fluid having an initial concentration of a first substance;

applying a skin permeabilizing device to the area of skin;

monitoring changes in the concentration of the first substance; and

controlling the skin permeabilizing device based on the changes in the concentration of the substance.

51. The method of claim 50, wherein the volume of fluid is selected from the group consisting of a liquid, a gel, and a solid.

52. The method of claim 50, wherein the first substance comprises an analyte.

53. The method of claim 52, wherein the step of controlling the skin permeabilizing device comprises discontinuing the application of the skin permeabilizing device when the concentration of analyte in the volume of fluid increases to a predetermined concentration.

54. The method of claim 50, wherein the step of controlling the skin permeabilizing device comprises discontinuing the application of the skin permeabilizing device when a rate of increase of analyte in the volume of fluid reaches a predetermined concentration.

55. The method of claim 50, wherein the step of controlling the skin permeabilizing device comprises decreasing an characteristic of skin permeabilizing device when the concentration of analyte in the volume of fluid increases to a predetermined concentration, said characteristic selected from the group consisting of intensity and duty cycle.

56. The method of claim 50, wherein the first substance comprises a benign substance and the initial concentration comprises a concentration higher than that found in the body.

57. The method of claim 56, wherein the step of controlling the skin permeabilizing device comprises discontinuing the application of the skin permeabilizing device when the concentration of the benign molecule in the volume of fluid decreases to a predetermined concentration.

58. The method of claim 56, wherein the step of controlling the skin permeabilizing device comprises discontinuing the application of the skin

permeabilizing device when the rate of change in the concentration of the benign molecule in the volume of fluid reaches a predetermined value.

59. The method of claim 56, wherein the step of controlling the skin permeabilizing device comprises decreasing an intensity of the skin permeabilizing device when the concentration of the benign molecule in the volume of fluid decreases to a predetermined concentration.

60. The method of claim 56, wherein the step of controlling the skin permeabilizing device comprises decreasing an intensity of the skin permeabilizing device when the rate of change in the concentration of the benign molecule in the volume of fluid reaches a predetermined value.

61. The method of claim 56, wherein the step of controlling the skin permeabilizing device comprises decreasing the intensity of a duty cycle of the skin permeabilizing device when the concentration of the benign molecule in the volume of fluid decreases to a predetermined concentration.

62. A method for enhancing permeability of an area of skin comprising:

creating a volume of fluid adjacent the area of skin;

determining a reference value for an electrical parameter of the volume of fluid;

applying a skin permeabilizing device to the area of skin;

monitoring changes in the electrical parameter of the volume of fluid; and

controlling the skin permeabilizing device based on the changes in the electrical parameter of the volume of fluid.

63. The method of claim 62, wherein the volume of fluid is selected from the group consisting of a liquid, a gel, and a solid.

64. The method of claim 62, wherein the electrical parameter is conductivity.

65. A method for regulating the permeabilization of an area of skin, comprising:

providing a first electrode in electrical contact with a first area of skin;

providing a second electrode in electrical contact with a second area of skin;

measuring an initial conductivity between said electrodes;

applying a skin permeabilizing device to said first area of skin;

measuring a second conductivity between said first and second electrodes;

processing said initial conductivity and said second conductivity to establish information on a time-variation of skin conductance;

calculating at least one parameter describing a kinetics of skin conductance changes responsive to said information; and

terminating said application of said skin permeabilizing device in response to a desired value for said at least one parameter.

66. The method of claim 65, wherein said application of said skin permeabilizing device is continuous.

67. The method of claim 65, wherein said application of said skin permeabilizing device is discontinuous.

68. The method of claim 65, wherein said skin permeabilizing device comprises an ultrasound-producing device.

69. The method of claim 65, wherein said step of calculating at least one parameter describing a kinetics of skin conductance changes responsive to said information comprises:

determining a slope of said information on a time-variation of skin conductance; and

determining a point of inflection for said information on a time-variance of skin conductance.

70. The method of claim 67, further comprising the steps of

performing analog to digital conversion on said information on a time-variation of skin conductance; and

filtering said digital data.

71. The method of claim 65, wherein said step of processing said initial conductivity and said second conductivity to establish information on a time-

variation of skin conductance comprises fitting said information into the following equation:

where:

$$C = Ci + \frac{(C_f - C_i)}{1 + e^{-S(t - t^*)}}$$

C is current;

C_i is current at t= 0;

C_f is the final current;

S is a sensitivity constant;

t^* is the exposure time required to achieve an inflection point; and

t is the time of exposure.

72. A method for extraction and analysis of at least one analyte in a body fluid, comprising:

increasing a permeability level of an area of skin;

extracting a body fluid from or through said area of skin;

collecting said body fluid; and

sensing the presence of said at least one analyte in the body fluid.

73. The method of claim 72, wherein said step of increasing a permeability level of an area of skin comprises applying ultrasound to said portion of skin.

74. The method of claim 72, wherein said step of extracting a body fluid from or through said area of skin comprises applying a force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum, electrical forces, osmotic forces, diffusion forces, electro-magnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo acoustic forces, by rinsing body fluid off skin, and any combination thereof.

75. The method of claim 74, wherein said vacuum force is applied continuously.

76. The method of claim 74, wherein said vacuum force is applied discontinuously.

77. The method of claim 74, wherein a material is placed between said vacuum force and said skin in order to maintain a surface configuration of said skin.

78. The method of claim 77, wherein said material is selected from the group consisting of mesh, membrane, and perforated metal.

79. The method of claim 77, wherein said vacuum force is generated by a device selected from the group consisting of mechanical, electro-mechanical, chemical, or electro-chemical.

80. The method of claim 74, wherein said electrical force is selected from the group consisting of iontophoretic, electro-osmotic, and electroporation.

81. The method of claim 74, wherein a gel is applied to said skin in order to encourage osmosis.

82. The method of claim 74, wherein said ultrasound force is applied to create a result, said result selected from the group consisting of to pumping body fluid and fluid components, levitating, activating gas bodies, producing cyclic impulse mechanical stress to the skin, creating microstreaming, increasing temperature, and setting up standing waves.

83. The method of claim 74, wherein a plurality of ultrasound-producing devices are used to create said ultrasound force.

84. The method of claim 83 wherein said a plurality of ultrasound-producing devices have at least one different operating characteristic.

85. The method of claim 84, wherein said operating characteristic is selected from the group consisting of frequency, intensity, and coupling media.

86. The method of claim 74, wherein said mechanical forces are applied by a device selected from the group consisting of a roller, a squeezer, a stretcher, a compressor, and a tensioner.

87. The method of claim 86, wherein said tensioner collects said body fluid in a cavity formed therein.

88. The method of claim 74, wherein said thermal forces are created by a source selected from the group consisting of electric, chemical, ultrasonic, and optical energy sources.

89. The method of claim 74, wherein temperature sensitive polymers are used to extract body fluids.

90. The method of claim 72, wherein said step of collecting said body fluid comprises using a collection method selected from the group consisting of absorption, adsorption, phase separation, mechanical, electrical, chemically induced, capillary forces, and a combination thereof.

91. The method of claim 90, wherein said absorption collection method comprises collecting said body fluid into a gel.

92. The method of claim 91, wherein said gel contains a captive enzyme.

93. The method of claim 90, wherein said phase separation method comprises isolating said body fluid with an appropriate density immiscible fluid.

94. The method of claim 93, further comprising collecting said body fluid into a conical chamber.

95. The method of claim 90 wherein a hydrophobic coating is applied to said skin prior to said step of extracting a body fluid from said area of skin.

96. The method of claim 75, wherein said body fluid is collected from said hydrophobic coating.

97. The method of claim 90, wherein said mechanical collection method comprises applying a force selected from the group consisting of vacuum, pressure, and acoustic forces.

98. The method of claim 90, wherein said electrical collection method comprises moving a charged object from said skin to a collecting compartment using electrical forces.

99. The method of claim 90, wherein said chemical collection method comprises applying a hydrophilic gel to collect body fluids.

100. The method of claim 90, wherein said capillary collection method comprises:

filling at least one capillary with a plurality of fibers; and

collecting said body fluid in said at least one capillary.

101. The method of claim 72, wherein said step of sensing the presence of at least one analyte comprises applying a sensing method selected from the group consisting of electrochemical, optical, acoustical, biological, enzymatic technology, and combinations thereof.

102. The method of claim 72, wherein living cells are used to sense a concentration of an analyte in body fluid.

103. The method of claim 72, further comprising the step of providing an output for a user interface comprises providing an alarm that indicates an abnormal analyte concentration.

104. The method of claim 72, further comprising the step of providing an output for a user interface comprises providing an trend information.

105. The method of claim 72, further comprising the step of providing history information.

106. The method of claim 72, wherein said user output is downloadable.

107. A system for extraction and analysis of at least one analyte in a body fluid comprising:

a transducer for increasing the permeability of an area of skin;

an extraction device for extracting interstitial fluid from said area of skin;

a collection device for collecting said extracted interstitial fluid; and

a sensing device for sensing the presence of at least one analyte in said extracted interstitial fluid.

108. The system of claim 107, further comprising a microcontroller for controlling at least one of said transducer, said extraction device, said collection device, and said sensing device.

109. The system of claim 107, further comprising a user output device.

110. The system of claim 108, further comprising a microcontroller for controlling said user output device.

111. The system of claim 107, wherein said transducer comprises an ultrasonic transducer.

112. The system of claim 107, wherein said extraction device is a device that produces a force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum pressure, electrical forces, osmotic forces, diffusion forces, electro-magnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo acoustic forces, by rinsing body fluid off skin, and any combination thereof.

113. The system of claim 107, wherein said collection device is a device that uses a collection method selected from the group consisting of absorption, adsorption, phase separation, mechanical, electrical, chemically induced, and a combination thereof.

114. The system of claim 107, wherein said sensing device is a device that senses the presence of an analyte by a sensing method selected from the group consisting of electrochemical, optical, acoustical, biological, enzymatic technology, and combinations thereof.

115. The system of claim 109, wherein said user output device provides information selected from the group consisting of trend information, history information, operating information, and combinations thereof.

116. The system of claim 115, wherein information from said user output device is downloadable to a computer.

117. A method for blood glucose determination comprising:

increasing a permeability of an area of skin;

extracting interstitial fluid from said area of skin;

collecting said interstitial fluid in a gel, said gel containing at least one glucose sensitive reagent that changes at least one characteristic of said gel when glucose is present; and

monitoring a change in said at least one characteristic of said gel.

118. A system for blood glucose determination comprising:

a transducer for increasing the permeability of an area of skin;

an extraction device for extracting interstitial fluid from said area of skin;

a collection device for collecting said extracted interstitial fluid;

a gel in said collection device;

at least one glucose sensitive reagent that changes at least one characteristic of said gel when glucose is present; and

a monitoring device for monitoring a change in said at least one characteristic of said gel.

119. The system of claim 118, wherein the at least one glucose sensitive reagent is in said gel.

120. A drug delivery patch apparatus, comprising:

a transducer for applying ultrasound to a membrane;

a power source coupled to said transducer;

a plurality of drug molecules between said transducer and said biological membrane;

an attaching device for attaching said drug molecules and said transducer to said membrane; and

a user interface that interacts with said transducer, said power source and said drug molecules.

121. The drug delivery patch apparatus of claim 120, further comprising drive electronics coupled to said transducer, said drive electronics enables said transducer to apply ultrasound.

122. The drug delivery patch apparatus of claim 120, wherein said membrane is skin.

123. The drug delivery patch apparatus of claim 120, wherein said drug molecules and said attaching device are combined.

124. The drug delivery patch apparatus of claim 120, wherein said drug molecules are suspended in the group consisting of a liquid, a gel, and a solid matrix.

125. The drug delivery patch apparatus of claim 120, wherein said power source is coupled to said transducer via hardwire.

126. The drug delivery patch apparatus of claim 120, wherein said power source is coupled to said transducer via telemetry.

127. The drug delivery patch apparatus of claim 120, wherein said transducer comprises acoustic elements, such that said acoustic elements are swept in a temporal nature as said transducer applies ultrasound.

128. The drug delivery patch apparatus of claim 120, wherein said attaching device includes a band for attaching to said membrane.

129. The drug delivery patch apparatus of claim 120, further comprising a feedback mechanism coupled to said drug molecules and said user interface for monitoring the amount of said drug molecules.

130. The drug delivery patch apparatus of claim 120, further comprising a feedback mechanism coupled to said transducer and said user interface for monitoring the amount of ultrasound applied to said membrane.

131. The drug delivery patch apparatus of claim 120, wherein said user interface is coupled to said transducer, said power source and said drug molecules by telemetry.

132. The drug delivery patch apparatus of claim 120, wherein said user interface is coupled to said transducer, said power source and said drug molecules by an infrared device.

133. The drug delivery patch apparatus of claim 120, wherein said user interface is coupled to said transducer, said power source and said drug molecules by fiber optics.

134. The drug delivery patch apparatus of claim 120, wherein said transducer is configured as a cylinder.

135. The drug delivery patch apparatus of claim 120, wherein said transducer is configured as a hollow cylinder.

136. The drug delivery patch apparatus of claim 120, wherein said transducer is a hemispherical configuration.

137. The drug delivery patch apparatus of claim 120, wherein said transducer is a conical configuration.

138. The drug delivery patch apparatus of claim 120, wherein said transducer is a planar configuration.

139. The drug delivery patch apparatus of claim 120, wherein said transducer is a rectangular configuration.

140. The drug delivery patch apparatus of claim 120, further comprising a device for creating a driving force that operates in conjunction with said transducer, said driving force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum pressure, electrical forces, osmotic forces, diffusion forces, electromagnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo-acoustic forces, by rinsing body fluid off skin, and any combination thereof.

141. The drug delivery patch apparatus of claim 120, further comprising a limiting step membrane between said membrane and said drug molecules.

142. The drug delivery patch apparatus of claim 120, wherein said membrane is pretreated by a force.

143. The drug delivery patch apparatus of claim 142, wherein said force is selected from the group consisting of physical forces, chemical forces, biological forces, vacuum pressure, electrical forces, osmotic forces, diffusion forces, electromagnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo-acoustic forces, by rinsing body fluid off skin, and any combination thereof.

144. A method for delivering a drug through a membrane, the method comprising the steps of:

supplying power to a transducer that applies ultrasound;

delivering drug molecules through said membrane by applying ultrasound to said drug molecules and having an attaching device for attaching at least said drug molecules and said transducer to said membrane.

145. The method of claim 144, further comprising the step of:

pre-treating said membrane by applying a force prior to said delivering step, said force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum pressure, electrical forces, osmotic forces, diffusion forces, electromagnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo-acoustic forces, by rinsing body fluid off skin, and any combination thereof.

146. The method of claim 144, wherein said delivering step includes applying a driving force in conjunction with said ultrasound from said transducer, said driving force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum pressure, electrical forces, osmotic forces, diffusion forces, electromagnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo-acoustic forces, by rinsing body fluid off skin, and any combination thereof.

147. A method for transdermal vaccination comprising:

increasing permeability of an area of skin;

providing a vaccine on said area of skin;

delivering said vaccine to at least one skin cell.

148. The method of claim 147, wherein said step of increasing a permeability of an area of skin comprises applying ultrasound to said area of skin.

149. The method of claim 147, wherein said step of providing a vaccine on said area of skin comprises providing a patch containing said vaccine on said area of skin.

150. The method of claim 147, wherein said step of providing a vaccine on said area of skin comprises providing a gel containing said vaccine on said area of skin.

151. The method of claim 147, wherein said step of providing a vaccine on said area of skin comprises providing a liquid containing said vaccine on said area of skin.

152. The method of claim 147, wherein said step of delivering said vaccine to at least one skin cell comprises diffusing said vaccine to said at least one skin cell.

153. The method of claim 147, wherein said steps of increasing a permeability of a area of skin and providing a vaccine on said area of skin are simultaneous.

154. The method of claim 147, wherein said vaccine is selected from the group consisting of a peptide, a protein, DNA, an allergen, and other antigens.

155. The method of claim 147, wherein said at least one skin cell is selected from the group consisting of Langerhans cells, dendric cells, and keratinocytes.

156. The method of claim 147, wherein said step of delivery said vaccine to said immune cell comprises applying a driving force selected from the group consisting of physical forces, chemical forces, biological forces, vacuum, electrical forces, osmotic forces, diffusion forces, electro-magnetic forces, ultrasound forces, cavitation forces, mechanical forces, thermal forces, capillary forces, fluid circulation across the skin, electro-acoustic forces, magnetic forces, magneto-hydrodynamic forces, acoustic forces, convective dispersion, photo acoustic forces, and any combination thereof

157. A method for transdermal vaccination and immunization, comprising:

applying ultrasound to irritate a area of skin; and

providing a vaccine to said area of skin.